



Exotic Invasive Plants of Southern Appalachia: An Activity Guide

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- ☐ Goals of Environmental Education

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Dear Middle School Teacher:

The Exotic Invasive Plant Species Curriculum contains 14 lesson plans written by a middle school teacher, Leslie Marra, from Knoxville Tennessee. In designing the lesson plans, Leslie took the needs of both the students and the teachers into consideration. All lesson plans are written:

- to take into consideration the cognitive, social, and affective development of middle school students;
- to support the students for success;
- to provide background information for the teacher relevant to each lesson;
- for one or two 45- to 50-minute periods; and
- to require few materials.

The lessons are designed to engage students in activities such as Web quests, school ground walks, art projects, chain tag, and a Jeopardy-like contest. This curriculum has a variety of activities, which are designed to engage and at times entertain.

If you know little about exotic invasive species you can still teach this curriculum. Lesson plans provide background information for the teacher. In addition, Web sites, such as Southern Appalachian Man and the Biosphere (<http://www.samab.org/Focus/Invasive/about.html>) provide pictures and flashcards of common exotic invasive species. You and your students can print picture of invasive plants and take them with you on a walk through the school grounds and neighborhood. You may be surprised how many common plants are exotic invasive species (e.g., mimosa tree and bush honeysuckle).

The project team designed the curriculum so that it addresses the North Carolina Science Standard Course of Study and the Tennessee Science Curriculum Standards. By teaching from this curriculum you will be addressing standards and learning outcomes related to ecosystems and scientific inquiry. In addition the curriculum works toward all five goals of environmental education—developing awareness, knowledge, skills and attitudes and giving students an opportunity to participate.

Recent research by the State Education and Environment Roundtable has shown that students enjoy studying their local environment. This curriculum focuses on the environment around your school and in your community. We hope it engages you and your students in the joy of learning about the world around you.

Sincerely,

Gary Peebles
Rosalyn McKeown
Jack Ranney
Leslie Marra

Background Information on Exotic Invasive Plant Species in the Southern Appalachian Region

Exotic invasive plant species are alien (non-native) plants that pose major economic and environmental threats in the Southern Appalachians, especially to natural areas. All states are having major problems with invasive plants. Until recently, little has been done to curb this threat other than in the agricultural sector. All kinds of natural areas, greenways, streamside zones, forests, and public rights-of-way are being affected. Managing these threats is costing a lot. Disregarding the threats allows them to become worse.

All non-native plants do not pose a threat. Presently there are 29 plant species listed by the Tennessee Exotic Pest Plant Council as posing “severe threats” to natural areas. Another 49 species are believed to pose “significant threats.” It is quite difficult to predict which new non-native plants will become invasive. Further, the data are only now being collected about the impacts and management of existing exotic invasive plants.

There is a 1999 presidential order (#13112 under President Clinton) requiring federal agencies to take action against invasive plants, to organize a National Invasive Species Council, and to develop a National Invasive Species Management Plan. In 2001, Government Accounting Office Report GAO-01-724 cited that federal agencies were moving too slow in the fight against the growing threat of invasive species.¹ Eventually state regulations will emerge in Tennessee to deal with the threat. None presently exist except for the agricultural noxious weed list.

Cornell University scientist estimated the US cost of non-native invasive species at \$137 billion per year.² This includes all invasive species (bugs, plants, diseases) for agriculture, forestry, environment, commerce, communities, and households. Some of these costs include power outages, loss of property value, increased operating costs, loss of game, and loss of endangered species. All of these problems that are attributable to invasive plants in the Southern Appalachians have not been ascertained, but the cost is probably high.

There are several perspectives in viewing the invasive plant problem. These include the principles of invasions that can help us understand how to control them. There are the causes and vectors of invasions that can help us understand how to prevent more invasions. And there are the economic and environmental impacts (and benefits) attributable to invasive plants that can help us choose which species to focus our efforts on and how to manage them. Unfortunately, the threat is so large and costs so high, it is unlikely that all invasive plants can be kept in check.

Threats to Native Ecosystems

Disruption of Ecosystems

Ecosystems are changed in many ways with the introduction of exotic invasive plant species. Biological diversity (biodiversity) is reduced as native species are displaced by exotic invasive species. Displacement is only the tip of the iceberg; invading species cause more problems. Exotic invasive species interfere with the reproduction of native species in several ways. The breeding of native species is altered, because there are fewer of them. Also, because many

invasive plants produce a lot of flowers they attract the native pollinators. Native pollinators visit the exotics, collecting pollen. Pollinators visit less showy native plants less frequently and when they do visit, they frequently carry pollen from the exotic invasive rather than native plant species. The rate of pollination drops for native species. Exotic invasive plants also disrupt seed dispersal of native plants. Exotic invasive plants tend to produce seeds prolifically. Animals, such as birds, eat the seeds of exotic invasive plants and then carry them afar depositing them along with their feces. Because the seed-eating animals get their fill on exotic invasive plants they eat, carry, and deposit the seeds of fewer native plants. In this way exotic invasive plants reproduce, but reproduction rates of native species are decreased. In some extreme cases invasions of exotic species can cause extinction of native species.

Changes to the ecosystem go beyond biodiversity. Nutrient cycling through the ecosystem is also changed as new plants take up, retain, decompose, and release nutrients at different rates than native species. Additionally, exotic invasive plants change fire patterns, as in the case of Cogon grass. Cogon grass creates a dense mat of materials that make it impossible for native plants to co-exist and cause more frequent and intense fires that injure or destroy native plants

Changes in the plant composition of an ecosystem have consequences on the animals within the ecosystem. Native plants provide forage for specific animals in an ecosystem. One well-known example of this is pandas only eat bamboo. If a native plant is crowded out, the animal that grazes on it loses that source of food, which can be disastrous for the animal. Another unexpected consequence of changing plant composition is a change in the food web within an ecosystem. For example, raccoons and possums have begun raiding of nests of native birds, such as the oven bird. Privet grows so thickly, that the predators can climb through it to low-lying branches of trees to raid bird nests. Of course, the consequences on the animal life in ecosystems invaded by native plants were unforeseen when many of the exotic invasive plants were introduced into the Southern Appalachian region.

Principles of Invasion

Although scientists³ have detailed the principles of biological invasions, it is sufficient to identify three phases—arrival, establishment, and spread. Of all the exotic, alien, hybrid, non-native, non-indigenous, horticultural and genetically modified plant species brought into Southern Appalachia, approximately 10 percent or less are able to actually establish themselves as “residents” able to sustain themselves in the Southern Appalachian environment. Of these, perhaps less than 10 percent become aggressive enough to spread and pose threats to native ecosystems.

A more systematic approach is needed to identify and predict non-native invasive plants. Work at the University of Florida (Dr. Alison Fox, Center for Aquatic and Invasive Plants) is underway to determine which plant traits are important in predicting an invasive threat. A few hints have been revealed. These traits include fast growth, early maturity to flowering and seed production, high seed production, and high tolerance of varying site conditions. An important point made by Williamson is that in today’s worldwide commerce and travel, invasive plants can spread rapidly any distance and in any direction. It follows that more arrivals raise the chances of establishment.

The shift from establishment to spread is very hard to predict. It can be within a few years as with Chinese silvergrass or several decades as with Oriental bittersweet. The speed of the transition from arrival to establishment to spread can be influenced by how much arrives over a given time period. That is, repeated introductions (arrivals) raise the chances of establishment and spread.

The biology of the plant and the means of seed dispersal affect its spread. Also, dispersal can be by human beings (intentionally as in landscaping or unintentional as in transporting seeds in packaging materials); by wildlife; by wind; by water; and by moving soil, straw, and other materials around. Establishment is often influenced by the condition of the environment. Usually, but not always, some kind of disturbance leads to more aggressive plant invasions. Forest clearing, right-of-way construction and maintenance (forest fragmentation), forest thinning, severe storms, flooding/drought, fire, over-browsing by deer, severe air pollution events, and habitat destruction for development are examples of disturbance.

All this suggests that prevention, early detection, and rapid response are vital strategies in reducing new invasive plant threats. These three strategies have been the foci of several government agencies and environmental groups.

Causes & Vectors of Invasion

For the most part, the causes of exotic plant invasions are people. People transport the new plants or seeds, and people are often the cause of forest disturbances that open ecosystems to plant invasions. Plant invasions in Southern Appalachia often start in urban areas and spread from there along rivers, highways, and various other kinds of rights-of-way. Increased development, shipping of nursery materials, and landscaping further facilitate invasions. Invasive species often leap-frog distances and establish new footholds.

It is clear that contributors to this problem are many and include development, landscaping, forest disturbance, commerce, and travel. However, in focusing on the solution, several groups have the opportunity to play important roles. These groups are right-of-way managers; the nursery, seed, and landscape industry; homeowners; communities; government agencies; developers; and conservation/volunteer groups. Efforts to control the spread of invasive plants need to focus on identification of pest plants and enforceable limitations on their use. Education of the nursery industry and homeowners about both the threats of invasive species and good non-invasive alternatives (native or exotic) is also important. With a better system of prevention, early detection and control, and community involvement we can make inroads in managing invasive plants.

Using Economic and Environmental Impacts to Strategize

Two facts dominate creating strategies to manage exotic invasive plant species. First, one cannot get all invasive plants satisfactorily under control in all areas. Second, invasive plants do not all pose the same threats nor do they impose the same level of threat. Considering these facts, what is the strategy for invasive plant management? Determining which invasive plants are most important to manage is a complex process. Seventy-eight plant species are listed as a severe or

significant threat in Tennessee, but the list is not easy to evaluate. The list is neither complete nor agreed upon by all segments of the public.

Factors that seem worthy of consideration include:

1. the ability to thwart or manage the invasion,
2. the extent and intensity of ecological damage to natural areas imposed by the plant species compared to other invasive plants,
3. the cost of thwarting or managing an invasion, and
4. the economic importance of the species (e.g., to the nursery industry) and whether suitable non-invasive alternatives can be identified/developed. Information is incomplete in all of these areas, making decisions more difficult. Prevention, early detection, and rapid response are easy to identify as priority strategies.

Table 1 is an example of how one might prioritize a list of 12 invasive plant species in the East Tennessee area. Priorities may change with geographic location and as better information becomes available. This list is not meant to be inclusive, nor does it necessarily consist of all the worst ones.

| Table 1: Theoretical approach to the management prioritization of invasive plant species | | | | | |
|---|----------------------------|--|----------------------------|-------------------------------|------------------------|
| Species Name | Prevention Capacity | Early Detection, Rapid Response | Ecological Severity | Economic Un-Importance | Priority Rating |
| Chinese silvergrass | 2 | 1 | 1 | 3 | High |
| Purple loosestrife | 1 | 1 | 1 | 1 | High |
| Cogon grass | 1 | 1 | 1 | 2 | High |
| Japanese knotweed | 2 | 1 | 1 | 2 | High |
| Tree of heaven | 3 | 3 | 1 | 1 | Medium |
| Japanese stiltgrass | 3 | 2 | 2 | 1 | Medium |
| Oriental bittersweet | 2 | 2 | 2 | 3 | Medium |
| Amur honeysuckle | 4 | 4 | 1 | 2 | Low |
| Euro/Chinese privet | 4 | 3 | 1 | 3 | Low |
| Kudzu | 2 | 2 | 3 | 2 | Low |
| Wintercreeper | 2 | 2 | 3 | 3 | Low |
| Burning bush | 2 | 1 | 3 | 4 | Low |
| 1=high, 2=moderate, 3=low, 4=none | | | | | |

Control Guidelines

There are multiple methods and strategies for controlling invasive plants. These winnow down to socio-economic, ecological, physical, chemical, and biological methods. Usually a combination of methods is desirable, as is the case with integrated pest management (IPM). Several sources of information are available on control methods for various lists of invasive plants. The Tennessee Exotic Plant List is available via the Internet at <http://tneppc.org> and the USDA National Invasive Species Information Center at <http://www.invasivespeciesinfo.gov/>.

Socio-economic controls refer to the buying and selling preferences by the nursery industry as well as the landscape and gardening public. Knowledge about the invasiveness of plants should

help the nursery industry promote alternatives and provide guidance as to what not to buy, plant, or propagate among homeowners and gardeners.

Ecological controls are approaches resource managers, forest owners, and other landowners can apply in the way they manage field edges, vegetation composition, forest disturbances, and the density of vegetative cover. Usually the idea is to crowd out or keep out invasive plant species by use of a thick plant cover. Quickly planting areas with aggressive, non-invasive plants is a big help. This is very important in site restoration where sites become more open to sunlight. Some invasive plants are shade-tolerant, but many are not. If an area is to be disturbed, it can be important to time this disturbance when local invasive plant seeds are not being actively dispersed.

Physical control involves hand-pulling, cutting down, mowing, girdling, digging up, root-grubbing, covering with black plastic, removing seed heads/flowers, and otherwise physically affecting a plant. Different approaches are needed for different-sized plants and different species. Often it is important to time these control efforts with specific seasons or conditions to be most effective. Examples of this are pulling up plants when the soil is soft so the roots come up, too; clipping annual grasses before they go to seed; and cutting plants during the early summer when root reserves are at their lowest. The positive aspects of this approach are that no chemicals are involved, the response is immediately observable, and non-target plants mixed in the invasive ones may be better protected. The negative aspects are that these labor-intensive techniques are generally only effective for small invasions; can disturb the soil, making way for more plants to invade (invasive plant seeds and root parts usually reside in the soil); usually require several years of follow-on treatment; and are not always effective. It often helps to replant non-invasive species to retard new invasions.

Chemical control is effective for larger-scale invasions but the right chemicals must be used in the right concentrations, be applied in the proper manner under the appropriate conditions, and be applied at particular times of year to be most effective. Without knowing about these things, it is easy to waste lots of herbicide without achieving effective control.

Conclusion

Invasive species are an ecological problem in the Southern Appalachian region with large economic implications. Citizens can do a lot to prevent the introduction and spread of invasive plant species, which in turn will protect the integrity of Appalachian ecosystems.

References:

- ¹ U. S. Government Accounting Office. "Invasive Species: Obstacles Hinder Federal Rapid Response to Growing Threat." GAO-01-724, July 2001.
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